REMARKS

Summary of the Office Action

In the Office Action, the Office:

- Rejected Claims 1, 8, 9, 15-17, 24, and 25 under 35 U.S.C. § 103(a) as being unpatentable over Harris (WO 02/060653) in view of Akin (U.S. Patent No. 4,565,104);
- Rejected Claims 3 and 10 under 35 U.S.C. § 103(a) as being unpatentable over Harris (WO 02/060653) in view of Akin (U.S. Patent No. 4,565,104) and in further view of Yamanaka (U.S. Patent No. 4,825,714);
- Rejected Claims 5-7 under 35 U.S.C. § 103(a) as being unpatentable over Harris (WO 02/060653) in view of Akin (U.S. Patent No. 4,565,104) and in further view of Zufle (U.S. Patent Application Publication No. 2003/0109953);
- Rejected Claim 18 under 35 U.S.C. § 103(a) as being unpatentable over Harris (WO 02/060653) in view of Akin (U.S. Patent No. 4,565,104) and in further view of Zimmerman (U.S. Patent No. 6,494,005); and

Claims 1, 3, 5-10, 15-18 and 24-25 are currently pending in this Application. By this Reply, Applicant has added Claims 26-29. Applicant respectfully submits no new matter was added by these amendments and that such amendments are fully supported by the Application as originally filed. Accordingly, Claims 1, 3, 5-10, 15-18 and 24-29 are at issue.

New Claims 26-29

Applicant respectfully requests examination of the new claims.

Rejections Based on Prior Art

Claim 1 requires the surgical robot head to be back-drivable wherein manual forces applied to the driving member by a user grasping the driving member cause the arm to rotate to a desired position, the motor responding to the manual forces to ensure that the arm moves smoothly to the position with constant low resistance in an unconstrained region and with increasing resistance towards a constraint boundary.

It is apparent that the term "back-drivable" has been misinterpreted by the Office. In particular, the Office repeats the incorrect contention that "[i]n the case of Akin the device is attached to a motor which can be run in forwards and reverse thus making a system back drivable." However, back-drivability is not simply an ability of a motor to run in two separate directions. As explained in Applicant's previous submissions, **back-drivability concerns the ability of a mechanical system to move the input axis from the output axis**.

In the present invention, back-drivability concerns the ability of a user (for example, a surgeon) to apply an external force to the manually graspable driving member and for that force to be transmitted back along the gear chain to the input motor. Driving a motor in forward and reverse does not comprise back-drivability since the motor is in both cases applying a torque to the input axis, in this case to the first lead screw.

The Office argued that "any linear screw and nut system, as in the Akin reference and the instant application, is back-drivable regardless of the thread pitch." While this may be true in an ideal system, given infinitely small friction and inertia, an infinitely large lever arm from the nut, and large motor torques, that is most definitely not the case in the real world. Particularly, with the device of Akin, given the screw thread shown, the size of the nut, and normal inertia and friction, there is absolutely no possibility of a user being able to move the load (such as an earth station antenna) merely by applying a manual force to it. That fact, Applicant submits, is absolutely clear and would be readily understood by anyone of ordinary skill reading the Akin reference.

Since Akin is not back-drivable, in the sense discussed, there would be absolutely no motivation for a skilled person to take the arrangement shown and to insert it into a surgical robot head as shown in Harris, in which back-drivability is an essential feature. Contrary to the Office's suggestion at lines 11 to 13 of page 8, the replacement of the drive system of Harris with that of Akin would most certainly alter the operation of Harris. Harris would no longer be back-drivable and would accordingly be completely useless as a surgical robot head of the type claimed by Applicant.

Claim 1 further requires the surgical robot head to be back-drivable wherein manual forces applied to the driving member by a user grasping the driving member cause the arm to

rotate to a desired position, the motor responding to the manual forces to ensure that the arm moves smoothly to the position with constant low resistance in an unconstrained region and with increasing resistance towards a constraint boundary. Claim 1 now explicitly provides that the head is back-drivable in that manual forces applied to the driving member by a user grasping the driving member cause the arm to rotate to a desired position. While Applicant fully understands that back-drivability *per se* is already known, and is indeed disclosed in Harris, it is the requirement for back-drivability in Claim 1 which prevents the structure of Akin from being usable.

Claim 1 further defines the way in which the back-drivability manifests itself. Claim 1 makes it clear that when force is applied to the manually graspable driving member, the motor responds to those forces to ensure that the arm moves smoothly to the desired position with low resistance in an unconstrained region and with increasing resistance towards a constraint boundary.

Mechanical Arrangement of Akin

Akin does not disclose or suggest any of the features set out in (d)(ii) of Claim 1. This specific mechanical arrangement is non-obvious and is of some considerable importance in the context of a surgical robot head.

Specifically, the claimed arrangement results in a very small pivot angle between the zero position of the lead screw and the maximal pivot position (compare the position of the screw in figure 4 and figure 6). In the context of surgical robotics, it is important to maintain as small a swing as possible, since a large swing would necessarily require a large case to cover the rotation control mechanism. As the Office will appreciate, in a surgical setting the internal mechanisms of the robot cannot normally remain exposed. A large case not only interferes with the surgeon's movements, but also makes it much more difficult to comply with the very strict limits on EM transmissions that apply to medical devices such as this.

Akin is concerned with a completely different problem, that of rotating a load through a large angle of 180° or more. At column 2, lines 13 to 16, Akin emphasizes how the mechanical arrangement described can in some circumstances produce a rotational angle of "well beyond 180°." This is a diametrically opposite problem from the one that has to be addressed by the

present invention, and the mechanical arrangement of Akin is accordingly quite different. Akin has maximal pivotal positions of the screw at each end of the nut's range of movement, with a zero position when the nut is in the centre, as shown in Figure 1 of Akin. As the nut moves along the screw, the screw pivots about the pivot shaft 16 from a first maximal position at one end to a second maximal position at least 180° distant at the other. The claimed distinction is fundamental and is indubitably non-obvious, particularly – and this again has to be stressed – since Akin lies in an entirely different area of engineering from Harris, and has absolutely nothing to do with the field of robotics.

In view of the foregoing, Applicant respectfully submits that Claim 1 is in condition for allowance. Claims 3, 5-10, 15-18 and 24-25 are also in condition for allowance based on their dependency from Claim 1.

Conclusion

As a result of the above Amendments and Remarks, Applicant respectfully submits that the Application is in condition for allowance. If any deficiencies remain, the Office is invited to telephone the undersigned to facilitate allowance of the claims.

Respectfully submitted,

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